

Appendix B - Benefit-Cost Analysis

The Benefit Cost Analysis (BCA) [see www.arkansashighways.com/TIGER/T4/92.aspx], was performed in accordance with the ARRA guidance provided in the Federal Register. These benefits and costs were quantified in accordance with the Federal Register Volume 77, Number 20, Docket No. DOT-OST-2012-0012 and Circulars A-4 [See <http://www.whitehouse.gov/omb/circulars/>].

The purpose of the BCA is to systemically compare the benefits and costs of replacing two structures along Highway 92 in Conway and Van Buren Counties, Arkansas. The BCA compared the cost of replacing the two structures to the cost of not doing anything outside of routine maintenance. The analysis considers a 20-year project life (2013 through 2033) for purposes of the BCA.

The analysis considered typical roadway construction and maintenance costs in Arkansas. Table 1 summarizes the findings of the BCA analysis of 3 percent discounted and Table 2 shows the finding of the BCA with 7 percent discounted. Road User Benefits that were considered include the value of travel time savings provided by the improved facility, vehicle operating cost benefits, and the value to society of enhancing the safety within the improved highway network.

Table 1: Benefit Cost Analysis Results (3 Percent Discounted)

Year	Activity	Construction and Maintenance Costs		Travel Time Benefit		Vehicle Operation Cost Benefit		Safety Benefits		Emissions (non Carbon Dioxide)	
		Non-Disc.	Discounted 3%	Non-Disc.	Discounted 3%	Non-Disc.	Discounted 3%	Non-Disc.	Discounted 3%	Non-Disc.	Discounted 3%
2013		\$1,916,000	\$1,916,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2014	(Construction	-\$8,320	-\$8,078	\$418,226	\$406,044	\$1,132,868	\$1,099,872	\$188,135	\$182,655	\$12,794	\$12,421
2015		-\$8,653	-\$8,156	\$430,772	\$406,044	\$1,166,854	\$1,099,872	\$193,779	\$182,655	\$13,178	\$12,421
2016		-\$8,999	-\$8,235	\$443,696	\$406,044	\$1,201,859	\$1,099,872	\$199,592	\$182,655	\$13,573	\$12,421
2017		-\$9,359	-\$8,315	\$457,006	\$406,044	\$1,237,915	\$1,099,872	\$205,580	\$182,655	\$13,980	\$12,421
2018		-\$9,733	-\$8,396	\$470,717	\$406,044	\$1,275,053	\$1,099,872	\$211,747	\$182,655	\$14,400	\$12,421
2019		-\$10,123	-\$8,477	\$484,838	\$406,044	\$1,313,304	\$1,099,872	\$218,100	\$182,655	\$14,832	\$12,421
2020		-\$10,527	-\$8,560	\$499,383	\$406,044	\$1,352,703	\$1,099,872	\$224,643	\$182,655	\$15,277	\$12,421
2021		-\$10,949	-\$8,643	\$514,365	\$406,044	\$1,393,284	\$1,099,872	\$231,382	\$182,655	\$15,735	\$12,421
2022		-\$11,386	-\$8,727	\$529,796	\$406,044	\$1,435,083	\$1,099,872	\$238,323	\$182,655	\$16,207	\$12,421
2023		-\$11,842	-\$8,812	\$545,690	\$406,044	\$1,478,136	\$1,099,872	\$245,473	\$182,655	\$16,693	\$12,421
2024		-\$12,316	-\$8,897	\$562,060	\$406,044	\$1,522,480	\$1,099,872	\$252,837	\$182,655	\$17,194	\$12,421
2025		-\$12,808	-\$8,983	\$578,922	\$406,044	\$1,568,154	\$1,099,872	\$260,422	\$182,655	\$17,710	\$12,421
2026		-\$13,321	-\$9,071	\$596,290	\$406,044	\$1,615,199	\$1,099,872	\$268,235	\$182,655	\$18,241	\$12,421
2027		-\$13,853	-\$9,159	\$614,178	\$406,044	\$1,663,655	\$1,099,872	\$276,282	\$182,655	\$18,788	\$12,421
2028		-\$14,408	-\$9,248	\$632,604	\$406,044	\$1,713,564	\$1,099,872	\$284,570	\$182,655	\$19,352	\$12,421
2029		-\$14,984	-\$9,337	\$651,582	\$406,044	\$1,764,971	\$1,099,872	\$293,108	\$182,655	\$19,932	\$12,421
2030		-\$15,583	-\$9,428	\$671,129	\$406,044	\$1,817,920	\$1,099,872	\$301,901	\$182,655	\$20,530	\$12,421
2031		-\$16,207	-\$9,520	\$691,263	\$406,044	\$1,872,458	\$1,099,872	\$310,958	\$182,655	\$21,146	\$12,421
2032		-\$16,855	-\$9,612	\$712,001	\$406,044	\$1,928,632	\$1,099,872	\$320,287	\$182,655	\$21,781	\$12,421
2033		-\$17,529	-\$9,705	\$733,361	\$406,044	\$1,986,491	\$1,099,872	\$329,895	\$182,655	\$22,434	\$12,421
TOTAL			\$1,738,641		\$8,120,885		\$21,997,433		\$3,653,099		\$248,424
			3% Discount								
			\$34,019,841	Discounted Benefit							
			\$1,738,641	Discounted Costs							
			19.57	Overall B/C							

Table 2: Benefit Cost Analysis Results (7 Percent Discounted)

Year	Activity	Construction and Maintenance Costs		Travel Time Benefit		Vehicle Operation Cost Benefit		Safety Benefits		Emissions (non Carbon Dioxide)	
		Non-Disc.	Discounted 7%	Non-Disc.	Discounted 7%	Non-Disc.	Discounted 7%	Non-Disc.	Discounted 7%	Non-Disc.	Discounted 7%
2013		\$1,916,000	\$1,916,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
2014	(Constructio	-\$8,320	-\$7,776	\$418,226	\$390,865	\$1,132,868	\$1,058,755	\$188,135	\$175,827	\$12,794	\$11,957
2015		-\$8,653	-\$7,558	\$430,772	\$376,253	\$1,166,854	\$1,019,175	\$193,779	\$169,254	\$13,178	\$11,510
2016		-\$8,999	-\$7,346	\$443,696	\$362,188	\$1,201,859	\$981,075	\$199,592	\$162,927	\$13,573	\$11,080
2017		-\$9,359	-\$7,140	\$457,006	\$348,648	\$1,237,915	\$944,400	\$205,580	\$156,836	\$13,980	\$10,665
2018		-\$9,733	-\$6,940	\$470,717	\$335,614	\$1,275,053	\$909,095	\$211,747	\$150,973	\$14,400	\$10,267
2019		-\$10,123	-\$6,745	\$484,838	\$323,068	\$1,313,304	\$875,110	\$218,100	\$145,329	\$14,832	\$9,883
2020		-\$10,527	-\$6,556	\$499,383	\$310,991	\$1,352,703	\$842,396	\$224,643	\$139,896	\$15,277	\$9,513
2021		-\$10,949	-\$6,372	\$514,365	\$299,365	\$1,393,284	\$810,904	\$231,382	\$134,666	\$15,735	\$9,158
2022		-\$11,386	-\$6,193	\$529,796	\$288,174	\$1,435,083	\$780,590	\$238,323	\$129,632	\$16,207	\$8,815
2023		-\$11,842	-\$6,020	\$545,690	\$277,401	\$1,478,136	\$751,409	\$245,473	\$124,786	\$16,693	\$8,486
2024		-\$12,316	-\$5,851	\$562,060	\$267,031	\$1,522,480	\$723,319	\$252,837	\$120,121	\$17,194	\$8,169
2025		-\$12,808	-\$5,687	\$578,922	\$257,048	\$1,568,154	\$696,279	\$260,422	\$115,631	\$17,710	\$7,863
2026		-\$13,321	-\$5,528	\$596,290	\$247,439	\$1,615,199	\$670,250	\$268,235	\$111,308	\$18,241	\$7,569
2027		-\$13,853	-\$5,373	\$614,178	\$238,189	\$1,663,655	\$645,194	\$276,282	\$107,147	\$18,788	\$7,286
2028		-\$14,408	-\$5,222	\$632,604	\$229,285	\$1,713,564	\$621,075	\$284,570	\$103,141	\$19,352	\$7,014
2029		-\$14,984	-\$5,076	\$651,582	\$220,713	\$1,764,971	\$597,857	\$293,108	\$99,286	\$19,932	\$6,752
2030		-\$15,583	-\$4,933	\$671,129	\$212,462	\$1,817,920	\$575,507	\$301,901	\$95,574	\$20,530	\$6,499
2031		-\$16,207	-\$4,795	\$691,263	\$204,520	\$1,872,458	\$553,993	\$310,958	\$92,001	\$21,146	\$6,256
2032		-\$16,855	-\$4,660	\$712,001	\$196,874	\$1,928,632	\$533,283	\$320,287	\$88,562	\$21,781	\$6,023
2033		-\$17,529	-\$4,530	\$733,361	\$189,514	\$1,986,491	\$513,347	\$329,895	\$85,251	\$22,434	\$5,797
TOTAL			\$1,795,701		\$5,575,643		\$15,103,012		\$2,508,147		\$170,563
			7% Discount								
			\$23,435,226	Discounted Benefit							
			\$1,795,701	Discounted Costs							
			13.05	Overall B/C							

Many benefits of this project do not easily lend themselves to simple quantification. The economic benefits of connecting timber rich areas of north central Arkansas to the mills and other secondary industries as well as providing a safe and efficient transportation network for the region cannot be easily quantified beyond the impacts of construction activities and travel time savings. Providing an improved transportation network in the region does make an impact in terms of improving the per capita income in areas of the country that are below the national average which is a goal of the TIGER Discretionary Grant program.

The BCA was calculated using the following key factors for evaluation:

- Construction Costs
- Operation and Maintenance Costs
- Forecasted Traffic
- Travel Speeds and Congestion
- Historic Crash Data
- Vehicles Miles Traveled
- Traffic Distribution by Vehicle Type
- Value of Time

The construction cost estimate for the improvement of the two structures along Highway 92 is \$1.93 million. These costs reflect basic construction costs that would be incurred if the project were built using traditional construction methods and schedules. A 3 percent inflation rate was applied to calculate future benefits and a 4 percent construction cost inflation rate was used to calculate future construction and maintenance costs.

Maintenance costs are also reported in this section. The two scenarios (replacing the bridges versus leaving the weight-restricted bridge in place) are different in the future maintenance needs and the road user costs. Without the bridge replacement, trucks used in the timber industries will face a significant detour to avoid steep grades and the weight-restricted routes and bridges. The costs of bridge maintenance have been taken into account and brought to present value. Cost associated with bridge construction and maintenance activities are reported in Attachment 1.

The BCA value of time analysis quantifies the road user impacts that the Highway 92 bridge improvements would have in terms of travel time savings by first determining the amount of travel time saved and then assigning a dollar value for this time. This includes differentiating time valuations by trip type, assuming passenger vehicle trips will not be impacted by the replacement of the structures since they are not subject to the detours caused by the weight-restrictions. The value of time for commercial vehicles was calculated as 100% of the total compensation. A vehicle occupancy rate of 1.0 person per commercial vehicle was used. Detailed worksheets showing factors considered for the Value of Time are included in Attachment 2.

The impacts of the vehicle operating costs account for the actual cost to operate the vehicle, aside from the travel time costs. Again, it should be noted that only commercial vehicles are considered in this calculation because passenger vehicles are not subject to the detour of the weight-restricted bridges. The detailed worksheets for this calculation are shown in Attachment 3.

The value of safety improvements considers cost savings that can be attributed to the reduction in travel distance by commercial vehicles, that will no longer have to detour through very congested conditions with a high volume of pedestrian movements. Crash rate reductions were estimated by determining the miles traveled along different facility types both under the detour route and using an improved Highway 92. Detailed worksheets illustrating this analysis are included in Attachment 4.

When examined as a single segment of improvements made within this corridor, the proposed bridge replacements along Highway 92 exhibits a net positive economic impact of 19.57.

REFERENCES

- User Benefit Analysis for Highways, August 2003, AASHTO
- Manual on User Benefit Analysis for Highway and Bus Transit Improvements, 1977, AASHTO
- Circular A-94, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs, Office of Management and Budget
- BCA.NET-Highway Project Benefit-Cost Analysis System User's Manual, Federal Highway Administration
- Memorandum: Department Guidance for the Valuation of Travel Time in Economic Analysis; Guidance for Conducting Economic Evaluations, April 9, 1997, US Department of Transportation
- Memorandum to Secretarial Officers Modal Administrators; Re: Treatment of the Economic Value of a Statistical Life in Departmental Analyses – 2009 Annual Revision; March 18, 2009
- Circular A-4: To the Heads of Executive Agencies and Establishments; Subject: Regulatory Analysis, September 17, 2003, Office of Management and Budget
- Federal Register (Volume 77, Number 20): Notice of Fund Availability for the Department of Transportation's National Infrastructure Investments Under the Full-Year Continuing Appropriations, 2012; and Request for Comments
- TIGER Benefit-Cost Analysis (BCA) Resource Guide (<http://www.dot.gov/tiger>)

ATTACHMENT 1

Highway 92 Construction and Maintenance Costs				
	Build	No-Build	DIFFERENCE	2013 Base Year \$
2012	\$0	\$0	\$0	
2013	\$1,930,000	\$14,000	\$1,916,000	\$1,916,000
2014	\$6,000	\$14,000	-\$8,000	-\$8,320
2015	\$6,000	\$14,000	-\$8,000	-\$8,653
2016	\$6,000	\$14,000	-\$8,000	-\$8,999
2017	\$6,000	\$14,000	-\$8,000	-\$9,359
2018	\$6,000	\$14,000	-\$8,000	-\$9,733
2019	\$6,000	\$14,000	-\$8,000	-\$10,123
2020	\$6,000	\$14,000	-\$8,000	-\$10,527
2021	\$6,000	\$14,000	-\$8,000	-\$10,949
2022	\$6,000	\$14,000	-\$8,000	-\$11,386
2023	\$6,000	\$14,000	-\$8,000	-\$11,842
2024	\$6,000	\$14,000	-\$8,000	-\$12,316
2025	\$6,000	\$14,000	-\$8,000	-\$12,808
2026	\$6,000	\$14,000	-\$8,000	-\$13,321
2027	\$6,000	\$14,000	-\$8,000	-\$13,853
2028	\$6,000	\$14,000	-\$8,000	-\$14,408
2029	\$6,000	\$14,000	-\$8,000	-\$14,984
2030	\$6,000	\$14,000	-\$8,000	-\$15,583
2031	\$6,000	\$14,000	-\$8,000	-\$16,207
2032	\$6,000	\$14,000	-\$8,000	-\$16,855
2033	\$6,000	\$14,000	-\$8,000	-\$17,529
Average maintenance costs are annualized				
Maintenance of Traffic costs are assumed to be negligible since bridges will be built on adjacent new location				

ATTACHMENT 2

Highway 92 Value of Time	
	380 Total Trucks
	Value of Time: 2010 BCA Manual, Table 5-2, 3% Annual Inflation ⁽¹⁾
	100 Trucks related to Timber Industry
Route 1 Detour	
\$28.00	Total Compensation per hour per person
1.00	Occupancy (Passengers per truck)
0.63	Time saved per Truck (Hours)
75	Number of Trucks per Day (75% of Total)
200	Working Days per year
\$266,029	Total Value of Time Savings per year ($\$28.00 * 1.00 * 0.63 * 285 * 200$)
Route 2 Detour	
\$28.00	Total Compensation per hour per person
1.00	Occupancy (Passengers per truck)
1	Time saved per Truck (Hours)
25	Number of Trucks per Day (25% of Total)
200	Working Days per year
\$140,015	Total Value of Time Savings per year ($\$28.00 * 1.00 * 0.01 * 95 * 200$)
	Travel Time Savings (Prim,, Arkansas to Morrilton, Arkansas)
	Time of Travel along Highway 92 Corridor
	2 hours, 12 minutes
	Time of Travel along Detour Route 1
	2 hours, 50 minutes -- 38 minutes longer than Highway 92 Corridor
	Time of Travel along Detour Route 2
	3 hours, 12 minutes -- 1 hour longer than Highway 92 Corridor
	1. Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis, September 28, 2011 specifies upper and lower limits of allowable Hourly Values of Travel Time Savings (Table 5) of \$29.60-\$19.80 in 2009 dollars. The \$28.00 value used in the analysis is based upon methodology stated above, is within the upper limits, and is applicable to local conditions and the trucking industry being analyzed.

ATTACHMENT 3

Worksheet 5-2: Operating and Ownership Cost			
General Information		Site Information	
Analyst	AJW/VHP/KKR	Facility	Hwy 92 bridges
Agency/Company	AHTD	Segment	N/A
Project	TIGER III	Analysis Time Period	annual
Date Performed	3/15/2012	Analysis Year	2013
		Segment Length (mi.)	N/A
Finance Rate: 3.0%			
Autos		Trucks	
Speed (mph):		Speed (mph):	
without improvement	N/A	without improvement	55
with improvement	N/A	with improvement	55
Fuel Cost Per Gallon	N/A	Fuel Cost Per Gallon	\$3.83
Fuel Consumption per Mile (Table 5-5):		Fuel Consumption per Mile (Table 5-5):	
without improvement	N/A	without improvement	0.163
with improvement	N/A	with improvement	0.163
Other Operating Costs per Mile (Table 5-4) (tires, maintenance, etc.)	N/A	Other Operating Costs per Mile (tires, maintenance, etc.)	\$0.050
Vehicle Life (years)	N/A	Vehicle Life (years)	8
Vehicle Cost	N/A	Vehicle Cost	\$60,000
Salvage Value at End of Life	N/A	Salvage Value at End of Life	\$5,000
Miles per Year	N/A	Miles per Year	50,000
		Cargo Value	\$0
Insurance per Year (Table 5-3)	N/A	Insurance per Year	\$1,500
Calculations			
Autos		Trucks	
Fuel Cost per VMT (Equation 5-3):		Fuel Cost per VMT (Equation 5-3):	
without improvement	N/A	without improvement	\$0.6243
with improvement	N/A	with improvement	\$0.6243
(cost per gallon X gallons per mile)		(cost per gallon X gallons per mile)	
Total Operating Cost per VMT:		Total Operating Cost per VMT:	
without improvement	N/A	without improvement	\$0.6743
with improvement	N/A	with improvement	\$0.6743
(fuel cost per VMT + other oper. cost)		(fuel cost per VMT + other oper. cost)	
Amortized Vehicle Cost Per Year:	N/A	Amortized Vehicle Cost Per Year:	\$7,985
	(Equation 5-6)		(Equation 5-6)

ATTACHMENT 3

Worksheet 5-2: Operating and Ownership Cost			
			Inventory Cost per Hour
			\$0.0000
			(Equation 5-10)
			Inventory Cost per Mile:
			without improvement
			\$0.0000
			with improvement
			\$0.0000
			(cost per hour / miles per hour)
		Amortized Vehicle Cost per VMT	N/A
		Insurance Cost per VMT	N/A
		Vehicle Cost per VMT	\$0.1597
		Insurance Cost per VMT	\$0.0300
		Ownership Cost per VMT	Ownership Cost per VMT
		without improvement	N/A
		with improvement	N/A
		(vehicle + insurance)	(vehicle + insurance + inventory)
		Ownership Cost per VMT	without improvement
			\$0.8640
		with improvement	\$0.8640
		Oper. and Ownership Cost per VMT	Oper. and Ownership Cost per VMT
		without improvement	N/A
		with improvement	N/A
		(operating + ownership)	(operating + ownership)
		Oper. and Ownership Cost per VMT	without improvement
			\$1.5383
		with improvement	\$1.5383
		Oper. and Ownership Savings / VMT	N/A
		(without - with)	(without - with)
			\$0.0000
			Detour 1
		\$1.5383	Owner and Operating Cost per VMT
		29	Miles Saved by Truck
		75	Number of Trucks per Day
		200	Working Days per year
		\$669,153	TOTAL SAVINGS PER YEAR
			Detour 2
		\$1.5383	Owner and Operating Cost per VMT
		56	Miles Saved by Truck
		25	Number of Trucks per Day
		200	Working Days per year
		\$430,719	TOTAL SAVINGS PER YEAR

ATTACHMENT 4

Safety Benefit Calculations					
Accident Costs					
Fatal	\$6,200,000				
Non-Fatal	\$85,408				
Statewide Average Crash Rates (2007-2009 Average, Crashes per MVM)					
	Total	Fatal	Non-Fatal		
Rural 2 Lane	1.03	0.00247	1.02753		
Urban 2 Lane	3.30	0.00152	3.29848		
Rural 4-Lane	1.01	0.00255	1.00745		
Urban 4-Lane	5.19	0.00143	5.18857		
Rural 4-Lane Freeway	0.39	0.00090	0.38910		
Urban 4-Lane Freeway	0.93	0.00081	0.92919		
Costs per VMT					
	Fatal	Non-Fatal			
Rural 2 Lane	\$0.0153	\$0.0878			
Urban 2 Lane	\$0.0094	\$0.2817			
Rural 4-Lane	\$0.0158	\$0.0860			
Urban 4-Lane	\$0.0089	\$0.4431			
Rural 4-Lane Freeway	\$0.0056	\$0.0332			
Urban 4-Lane Freeway	\$0.0050	\$0.0794			
Mileage of Alternate Routes					
	Detour 1	Detour 2	Highway 92	Detour 1 Increase	Detour 2 Increase
Rural 2 Lane	93.3	76.19	73.44	19.86	2.75
Urban 2 Lane	8.51	6.46	2.65	5.86	3.81
Rural 4-Lane	7.24	14.27	0	7.24	14.27
Urban 4-Lane	10.31	6.61	0.09	10.22	6.52
Rural 4-Lane Freeway	0	26.33	0	0	26.33
Urban 4-Lane Freeway	0	28.27	0	0	28.27
Total Number of Miles:					
	Detour 1	Detour 2			
Trucks per Day	75	25			
Work days per year	200	200			
Miles Saved Per Year:					
Rural 2 Lane	297900	13750			
Urban 2 Lane	87900	19050			
Rural 4-Lane	108600	71350			
Urban 4-Lane	153300	32600			
Rural 4-Lane Freeway	0	131650			
Urban 4-Lane Freeway	0	141350			
Cost Saved per Year					
Rural 2 Lane	\$30,706	\$1,417			
Urban 2 Lane	\$25,591	\$5,546			
Rural 4-Lane	\$11,061	\$7,267			
Urban 4-Lane	\$69,293	\$14,736			
Rural 4-Lane Freeway	\$0	\$5,110			
Urban 4-Lane Freeway	\$0	\$11,927			
TOTAL ANNUAL SAVINGS	\$182,655				

ATTACHMENT 4

TIGER IV		HWY 92, Bridge Replacement							
100 timber trucks using max load of 80,000 lb per day									
100 X 80,000 =		8,000,000	lb	truck mpg =	4.5				
50%	HWY 92	4,000,000	lb						
35%	Route 1	2,800,000	lb						
15%	Route 2	1,200,000	lb						
	miles	min	Max Load	Trips (Forest to Mill)	Trips (Mill to Forest)	Total trip	VMT	Time	
HWY 92	76	109	62,000	65	115	179	13,606	19,515	
Route 1	105	137	80,000	35	0	35	3,675	4,795	
Route 2	132	173	80,000	15	0	15	1,980	2,595	
					Sum		19,261	26,905	
					gallon of fuel		4,280		
					assume fuel price	\$ 3.80	\$ 16,265		
Only using HWY 92 with bridges replaced									
	miles	min	Max Load	Trips (Forest to mill)	Trips (Mill to Forest)	Total trip	VMT	Time	
HWY 92	76	109	80,000	100	100	200	15,200	21,800	
					gallon of fuel		3,378		
					assume fuel price	\$ 3.80	\$ 12,836		
Emission Factors from Mobile 6, 2009 VOC 1.42 gram/mile NOX =1.50 gram/mile									
Assuming 50 weeks a year, work 5 days a week 52*5=250									
		VMT	fuel (Gallon)	Cost	Time (hr)	VOC (tons/day)	NOX (tons/day)	VOC (tons/year)	NOX (tons/year)
No Bridge Replacement		19,261	4,280	\$ 16,265	448	0.030	0.032	7.522	7.945
With Bridge Replacement		15,200	3,378	\$ 12,836	363	0.024	0.025	5.936	6.270
Difference per day		4,061	903	\$ 3,430	85	0.006	0.007	--	--
Difference per year		1,015,363	225,636	\$ 857,418	21,269	--	--	1.586	1.675
Conversion Factor (grams to tons)									
=	1 ton / 2000 lbs X 2.2 lbs / 1 kg X 1 kg / 1000 grams			=	1.1 X 10^-6	tons/gram			
Emission Type \$ / long ton (2 \$ / metric ton (2007\$))									
Carbon dioxide (CO2)	(varies*)	(varies*)				VOC (tons/year)	NOX (tons/year)		
Volatile Organic Compounds	\$ 1,300.00	\$ 1,280.00				1.585996855	1.67534879		Hwy 92
Nitrogen oxides (NOx)	\$ 5,300.00	\$ 5,217.00		2007\$	\$ 2,061.80	\$ 8,879.35			
Particulate Matter (PM)	\$ 290,000.00	\$ 285,469.00		2012\$ using CPI	2253.942618	9706.8493			
Sulfur dioxide (SOx)	\$ 31,000.00	\$ 30,516.00		2012\$ using GDP	2340.706154	10080.5059			
* See "Social Cost of Carbon (3%)" values.									

ATTACHMENT 4

Estimation of Accident Costs		
\$6,200,000	Value of a Statistical Life (VSL)	
	http://ostpxweb.dot.gov/policy/reports/vsl_guidance_072911.pdf	
Disutility Factors by Injury Severity Level		
Severity	Fraction of VSL	
MAIS 1	0.003	
MAIS 2	0.047	
MAIS 3	0.105	
MAIS 4	0.266	
MAIS 5	0.593	
MAIS 6	1	
KABCO-AIS Conversion Table		
	Unknown if	
	Injured	Fatal
AIS 0	0.43676	0
AIS 1	0.41739	0
AIS 2	0.08872	0
AIS 3	0.04817	0
AIS 4	0.00617	0
AIS 5	0.00279	0
Fatality (6)	0	1
Cost of Accident		
Non-Fatal	\$85,408	
Fatal	\$6,200,000	